Fermilab

Directorate

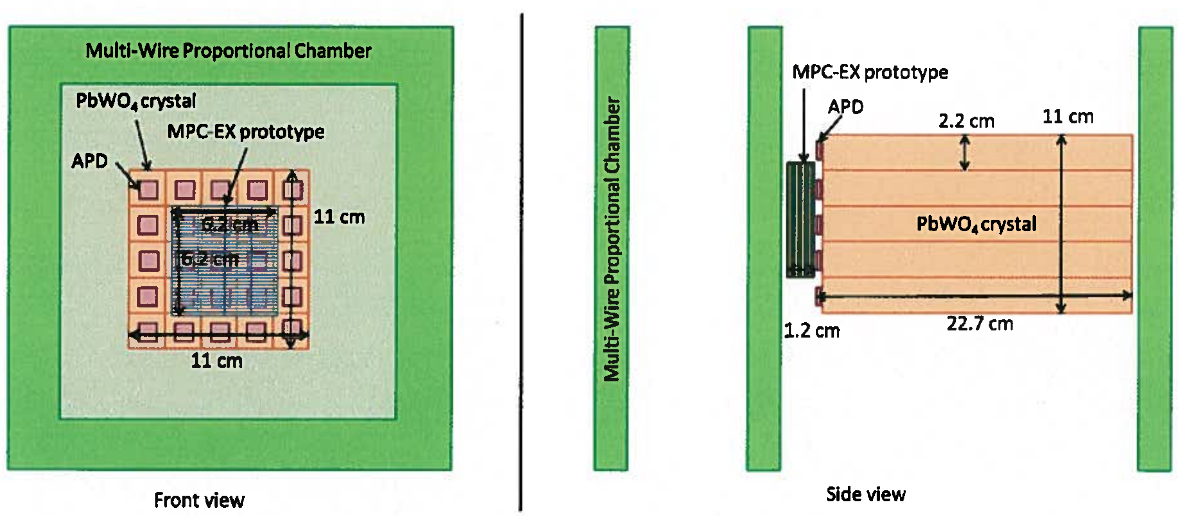
TECHNICAL SCOPE OF WORK

FOR THE 2013 – 2014 FERMILAB TEST BEAM FACILITY PROGRAM

T-1038

PHENIX Muon Piston Calorimeter (MPC) APD and Prototype MPC Extension (MPC-EX) Tests

June 20, 2013



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INTRODUCTION

This is a technical scope of work (TSW) between the Fermi National Accelerator Laboratory (Fermilab) and the experimenters of Muon Piston Calorimeter Extension (MPC-EX) Collaboration who have committed to participate in beam tests to be carried out during the 2013-2014 Fermilab Test Beam Facility program.

The TSW is intended primarily for the purpose of recording expectations for budget estimates and work allocations for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to modify this scope of work to reflect such required adjustments. Actual contractual obligations will be set forth in separate documents.

This TSW fulfills Article 1 (facilities and scope of work) of the User Agreements signed (or still to be signed) by an authorized representative of each institution collaborating on this experiment.

Description of Detector and Tests:

The MPC-EX detector system consists of a W-Si preshower extension added in front of the existing forward Muon Piston Calorimeters (MPCs) in the PHENIX detector. This system will improve the discrimination between electromagnetic and hadronic showers and provide the separation of high p_T pions and prompt photons in the forward direction in p+A and polarized p+p collisions at RHIC.

The MPC-EX preshower detector has eight sampling layers. Each layer consists of two identical carrier boards attached to the 2 mm thick tungsten absorber plates. The carrier boards are 3 mm deep and contain 12 plug-in modules with silicon sensors and readout ASICs. The 62x62 mm^2 silicon sensors consist of 34x4 1.8x15 mm^2 minipads. The minipad orientation alternates between X and Y in sequential layers resulting in a two-layer granularity of about 2x2 mm^2. The signal from each minipad is split with a ratio of 30:1 with individual copies sent to two independent SVX4 chips. The total depth of the preshower ($\sim 4X_0$) allows both photons from neutral pion decay to convert and be reliably measured in at least two X and two Y sampling layers. [1]

The MPC detector consists of PbWO4 crystals with Hamamatsu avalanche photodiodes (APDs – model S8664-5) attached to the front of the crystals. The APDs convert the scintillation light produced in the crystals into charge signals. The MPC crystals were donated by the Kurchatov Institute and were developed for the PHOS detector in ALICE. [2]

The experimenters propose two short experiments. First the experimenters will test the nuclear counter effect on the APD response by using 32 GeV pions from the Fermilab test beam to generate a MIP in the crystals and compare the signal response for tracks traveling through the APDs and those not. Second, the experimenters will use the 2-32 GeV electron beam to test the response from a MPC-EX prototype placed in front of the APDs and crystals. These tests will provide important information for the simulation and implementation of the combined MPC-EX system and the construction of the new preshower detector.

Nuclear Counter Effect in APDs

The nuclear counter effect is the result of charged particles in the APD depositing ionizing radiation in the APD's silicon. When deposited before the avalanche region, these leakage charges will be amplified by the same amount as the light. When deposited after the avalanche region, these charges will undergo a reduced amplification. Depending on the size of the depleted region in front of the APD's avalanche region and terminal capacitance, these leakages result in a high-side tail in the energy distributions as seen in Figure 1. These tails degrade the energy resolution of the calorimeter. This effect has been measured by CMS with high momentum muon test beam studies at the CERN SPS-H4 beam line using high and low capacitance S5345 Hamamatsu APDs and EG&G C30626E APDs [3]. The experimenters hope to perform a similar test for the Hamamatsu S8664-5 APDs used in the MPC at PHENIX.

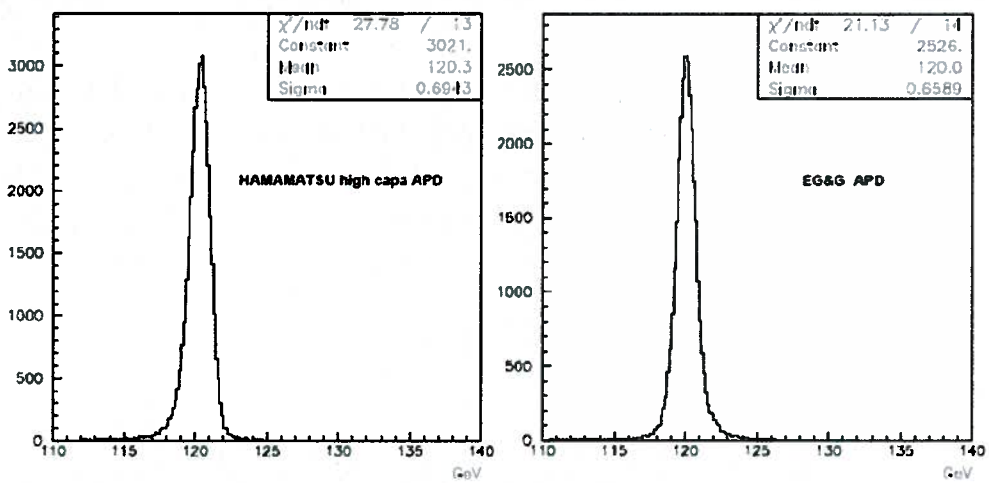


Figure 1: Energy spectra for 120 GeV electrons using Hamamatsu high capacitance APDs on the left and EG&G APDs on the right. The EG&G APDs show a small high-side tail in the distribution. This tail is not visible in the Hamamatsu high capacitance APDs. [3]

In the MPC, the APDs are placed in front of the MPC crystals to avoid this type of leakage from charged particles exiting the back of the MPC crystals. With the MPC-EX installed in front of the MPC APDs, electromagnetic showers will begin to shower before the MPC APDs resulting in a significant increase in the amount of charged particle flux seen at the APDs. The amount of energy from this flux has been calculated according to Equation 1.1

$$E_{Flux} = N_{MIP} * 0.7 * A_{APD}/A_{Crystal} * E_{MIP}$$

where N_{MIP} is the estimation of the number of charged particles generated by a shower, and A_{APD} and $A_{Crystal}$ are the APD and crystal areas and E_{MIP} is the expected additional energy in the APD from a MIP. The APD and crystal areas are 25 mm^2 and 400mm^2 respectively. The CMS test beam results found E_{MIP} to range from 145 to 520 MeV for APDs with a gain of 50.

PHENIX GEANT simulations are used to estimate N_{MIP} by calculating the ratio of the ionization energy in the last layer of the MPC-EX Si and the energy deposited by a MIP in Si of the same thickness (~300 microm ~116 keV). The average number of MIPS generated by an electromagnetic shower is energy dependent resulting in values between 6 MIPs/GeV and 5.4 MIPs/GeV for 5 to 10 GeV and 35 GeV showers respectively. This estimate does not consider that some low energy particles will stop and deposit all of their energy in the Si resulting in a conservative over-estimate. [1]

Prototype test

Remaining beam time will be used to conduct a prototype test by sliding a small 6.2x6.2 cm^2 prototype of the MPC-EX preshower in front of the MPC crystal and APD structure. The prototype will consist of 3 or 4 layers of W plates and Si modules with a depth of 0.9 or 1.2 cm. Preproduction Si sensors will most likely be used. A previous test beam study at Fermilab of the $PbWO_4$ crystals showed a linear response with energy and an energy resolution of 14%/sqrt(E) + 3% [4]. The experimenters are interested in studying the change in detector response with the addition of the preshower using an electron-tagged beam.

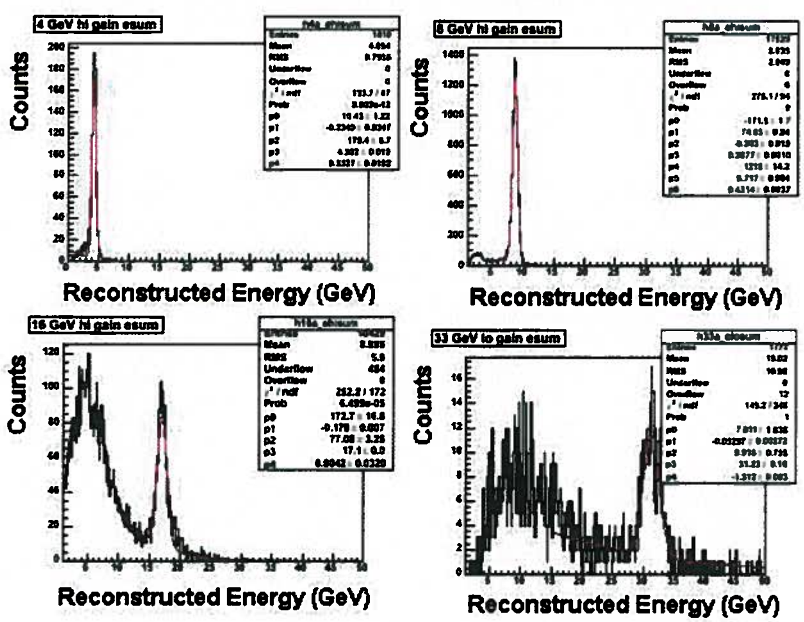


Figure 2: The reconstructed energy distribution at beam energies of 4, 8, 16, 32 GeV shown with a polynomial with Gaussian fit. [4]

I. Personnel and Institutions:

Spokespersons: Sarah Campbell and Richard Seto

Fermilab liaison: Aria Soha

The group members at present are:

	Institution	Country	Collaborator	Rank/Position	Other Commitments
1.1	Iowa State University	USA	John Lajoie	Professor	PHENIX
			Roy McKay	Assistant Scientist	
			Sarah Campbell	Post-doc	PHENIX
			Arbin Timilsina	Graduate Student	PHENIX
			Josh Perry	Graduate Student	PHENIX
			Shawn Whittaker	Graduate Student	PHENIX
1.2	Augustana College	USA	Nathan Grau	Professor	PHENIX
			unnamed	Undergraduates	
1.3	Brookhaven National Laboratory	USA	Edouard Kistenev	Scientist	PHENIX
			Martin Purschke	Scientist	PHENIX
			Andrey Sukhanov	Engineer	PHENIX
1.4	University of California Riverside	USA	Richard Seto	Professor	PHENIX
			Kenneth Barish	Professor	PHENIX
			Richard Hollis	Assistant Project Scientist	PHENIX
			Aneta Iordanova	Assistant Project Scientist	PHENIX
			David Black	Graduate Student	PHENIX
			Louis Garcia	Graduate Student	
1.5	Los Alamos National Laboratory	USA	Micheal Leitch	Retired Associate Fellow	PHENIX
			Xiaodong Jiang		PHENIX
			Ming Lui		PHENIX
			Jin Huang	Post-doc	PHENIX
1.6	Yonsei University, IPAP	Korea	Young Il Kwon	Professor	PHENIX
			Ju Hwan Kang	Professor	
			J. H. Do		
			H. J. Kim		
			Sang Hoon Lim		
			M. Song		
1.7	Chonbuk National University	Korea	Eun-Joo Kim	Professor	PHENIX
1.8	Ewha Womens University	Korea	Kevin Insik Han	Professor	PHENIX
			Dahee Kim	Graduate Student	PHENIX
			Seyoung Han	Graduate Student	PHENIX

1.9	Hanyang University	Korea	Byoung Hwi Kang		
			Yong Kyun Kim		
			Jeong Soo Kang		
			Junsik Park		

II. Experimental Area, Beams and Schedule Considerations:

2.1 Location

2.1.1 The beam test(s) will take place in MT6.2B or 2C, depending on availability.

2.1.2 Additional work space in either of the control rooms or counting room is needed for the DAQ setup and as a general work area.

2.2 Beam

2.2.1 Beam Types and Intensities

Energy of beam: 4, 8, 16, 32 GeV
Particles: pions, electrons
Intensity: 10k – 100k in units of particles/ 4 sec spill
Beam spot size: about $10cm^2$

Initially a low energy pion beam with a ~11cm spot size is required. Remaining time will be used for an electron beam over a range of energies including 4, 8, 16, 32 GeV

2.2.2 Beam Sharing

The small size of the detector setup and the movable table should make moving the system out of the beam easy to accommodate beam sharing.

2.2.3 Running Time

The experimenters will need 5-6 days of beam assuming shifts of 12 hours/day. The first two days will consist of a pion beam used for the APD test. Then an access will be needed to slide the MPC-EX prototype into the system. The prototype will remain in for the remainder of the beam time using the electron beam over an energy range from 4 to 32 GeV. See section 2.3.3 for total run time and long-term schedule.

2.3 Experimental Conditions

2.3.1 Area Infrastructure

A 5x5 array of wrapped crystals with APDs glued to the front will be placed in a light tight box on the MT6.2B or 2C movable table. The crystal array has approximate dimensions of $11x11x22.7\ cm^3$. Each $PbWO_4$ crystal tower is $2.2x2.2x18.5\ cm^3$ with a density of $8.28\ g/cm^3$. The crystal weight contribution to the 5x5 array is approximately 40 lbs. The 18.5cm deep

PbWO4 crystals have a nuclear interaction length of 22.4 cm [4]. Three multi-wire proportional counters will be used, two in front of and one behind the APD and crystal stack. The multi-wire proportional counters are necessary to determine the particle's entrance and exit from the crystal array and identify straight tracks which pass through the APD. Trigger paddles of at least 11x11 cm^2 will be placed in front and behind the tower and multi-wire proportional chamber setup to facilitate triggering. The laser alignment system will be used to align the center of the crystal array and MWPCs with the beam. The Cherenkov counters will allow us to identify pions and electrons in the beam. A CAMAC-based DAQ will be used to read out the data with an Ethernet connection to MPC-EX computers.

For the second test an MPC-EX prototype of 4 W and Si layers will be slid in front of the crystal array. The prototype is 6.2x6.2x1.2 cm^3 and will be placed in front of the central 3x3 crystals in the 5x5 array according to Figure 3. Tungsten has an interaction length of 9.95 cm and silicon has an interaction length of 46.52 cm [5]. With the four layers of W and Si, each with a one-layer depth of 2 mm and 1 mm respectively, the depth of the MPC-EX prototype is 1.2 cm, well below the interaction lengths of either W or Si. The multi-wire proportional chambers, Cherenkov counter and trigger paddles will be provided by the Fermilab Test Beam Facility. The CAMAC crate and NIM crates for triggering will be provided by the PREP equipment pool. The MPC-EX group will bring the wrapped crystal and APD array with a light tight box and the MPC-EX prototype.

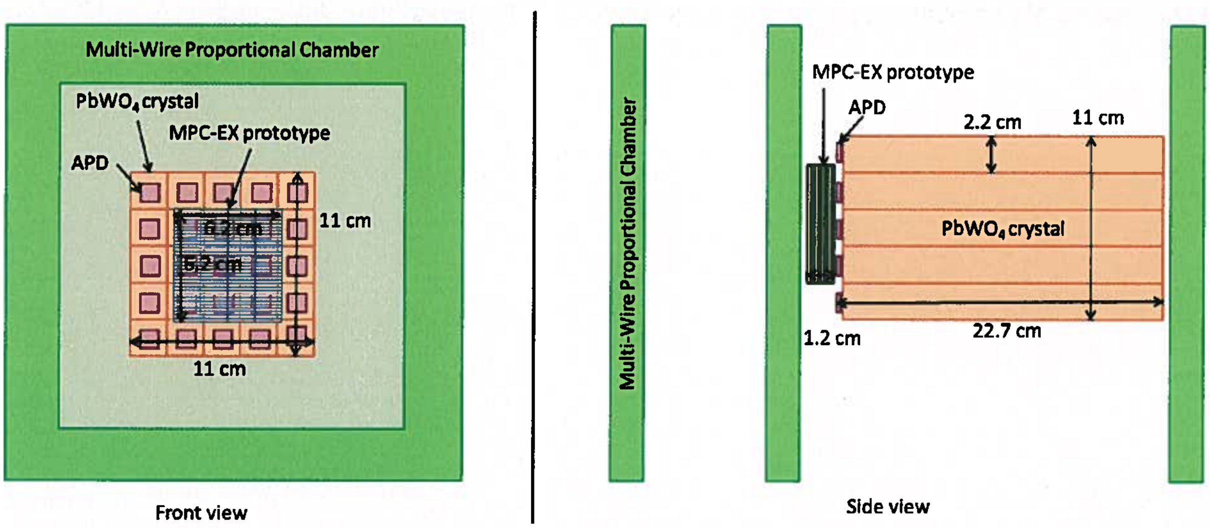


Figure 3: Front and side view diagram of the MPC-EX prototype setup. The multi-wire proportional chambers (green), the APDs and crystals (red) and the MPC-EX prototype (blue and brown) are shown. The trigger paddles and Cherenkov counters are not shown.

2.3.2 Electronics Needs

HV power supply.

Documentation on custom readout board will be provided to Fermilab Test Beam Facility staff prior to setting up.

2.3.3 Description of Tests

The experimenters request approximately a week of beam time. Here is a breakdown of the usage of days:

Day 1) Setup detector and obtain Operational Readiness Clearance

Days 2-3) Low energy pion beam for APD nuclear counter effect test

Days 4-7) Electron beam for MPC-EX prototype test

Day 8) Remove detector

For the low energy pion beam the experimenters would like an 11 cm beam spot. During the electron beam the Cherenkov counter will be used to tag electrons in the secondary beam. The experimenters would like to study electrons at 4, 8, 16, and 32 GeV to see the prototype response at a range of energies.

While no activation of the detector materials is expected, to the experimenters will follow Fermilab's activation check protocols to survey the materials at the end of the schedule to confirm this and comply with Fermilab's safety standards – specifically Fermilab Radiological Control Manual Chapter 4. Any issues of activated material will be coordinated by the Area Radiation Safety Officer (RSO).

2.4 Schedule

The summer of 2013 is the ideal time for this measurement because students are involved in shift taking. Additional return dates are not expected.

III. RESPONSIBILITIES BY INSTITUTION – NON FERMILAB,

3.1 THE MPC-EX GROUP

The wrapped crystal array, MPC-EX prototype and respective readout electronics will be brought and setup by the MPC-EX group. Shifts will be provided by MPC-EX group members including students at Iowa State University, Augustana College and UC Riverside. Brookhaven National Laboratory will provide data acquisition expertise, readout electronics and additional equipment. The experimenters will take responsibility for analyzing the data and taking down the equipment at the end of the experiment.

IV. Responsibilities by Institution – Fermilab

4.1 Fermilab Accelerator Division:

4.1.1 Use of MTest beamline as outlined in Section II.
4.1.2 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.
4.1.3 Scalers and beam counter readouts will be made available via ACNET in the MTest control room.
4.1.4 Reasonable access to the equipment in the MTest beamline.
4.1.5 Connection to beams console and remote logging (ACNET) should be made available.
4.1.6 The test beam energy and beam line elements will be under the control of the AD Operations Department Main Control Room (MCR). [0.5 person-weeks]
4.1.7 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.
4.1.8 The integrated effect of running this and other SY120 beams will not reduce the neutrino flux by more than an amount set by the office of Program Planning, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.2 Fermilab Particle Physics Division:

4.2.1 The test-beam efforts in this TSW will make use of the Fermilab Test Beam Facility. Requirements for the beam and user facilities are given in Section II. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and FTBF computers. [1.0 person weeks]
4.2.2 Set up and maintenance of Multi-Wire Proportional Chamber tracking system.
4.2.3 Set up and maintenance of Cherenkov counter
4.2.4 Provide two scintillator paddles for triggering
4.2.5 Conduct a NEPA review of the experiment.
4.2.6 Provide day-to-day ESH&Q support/oversight/review of work and documents as necessary.
4.2.7 Provide safety training as necessary, with assistance from the ESH&Q Section.
4.2.8 Update/create ITNA's for users on the experiment.
4.2.9 Initiate the ESH&Q Operational Readiness Clearance Review and any other required safety reviews. [0.2 person-weeks]

4.3 Fermilab Scientific Computing Division

4.3.1 Internet access should be continuously available in the MTest control room.
4.3.2 See Appendix II for summary of PREP equipment pool needs.

4.4 Fermilab ESH&Q Section

4.4.1 Assistance with safety reviews.

4.4.2 Provide safety training, with assistance from PPD, as necessary for experimenters. [0.2 person weeks]

V. SUMMARY OF COSTS

Source of Funds [$K]	Materials & Services	Labor (person-weeks)
Particle Physics Division	0.0	1.0
Accelerator Division	0	0.5
Scientific Computing Division	0	0
ESH&Q Section	0	0.2
Totals Fermilab	$0.0K	1.7

I. GENERAL CONSIDERATIONS

6.1 The responsibilities of the Spokespersons and the procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Researchers": (http://www.fnal.gov/directorate/PFX/PFX.pdf). The Spokespersons agree to those responsibilities and to ensure that the experimenters all follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ESH&Q) reviews are necessary. This includes creating an Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The Spokespersons will follow those procedures in a timely manner, as well as any other requirements put forth by the Division's Safety Officer.

6.3 The Spokespersons will ensure at least one person is present at the Fermilab Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ESH&Q section.

6.5 All items in the Fermilab Policy on Computing will be followed by the experimenters. (http://computing.fnal.gov/cd/policy/cpolicy.pdf).

6.6 The Spokespersons will undertake to ensure that no PREP or computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Scientific Computing Division management. The Spokespersons also undertake to ensure no modifications of PREP equipment take place without the knowledge and written consent of the Computing Sector management.

6.7 The experimenters will be responsible for maintaining both the electronics and the computing hardware supplied by them for the experiment. Fermilab will be responsible for repair and maintenance of the Fermilab-supplied electronics listed in Appendix II. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

At the completion of the experiment:

6.8 The Spokespersons are responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the Spokespersons will be required to furnish, in writing, an explanation for any non-return.

6.9 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ESH&Q requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters unless removal requires facilities and personnel not able to be supplied by them, such a rigging, crane operation, etc.

6.10 The experimenters will assist Fermilab with the disposition of any articles left in the offices they occupied.

6.11 An experimenter will be available to report on the test beam effort at a Fermilab All Experimenters' Meeting.

VII. Bibliography

1. S. Campbell et al., "A Proposal for the Muon Piston Calorimeter Extension (MPC-EX) to the PHENIX Experiment at RHIC" 2012. arXiv:1301.1096

2. M. Ippolitov et al., "Muon Piston Calorimeter Letter of Intent" 2005. https://www.phenix.bnl.gov/WWW/p/draft/chiu/mpc/MPC_LOI_v3.pdf

3. A. Karar, et al., "Investigation of Avalanche Photodiodes for EM Calorimeter at LHC" 1995. CMS Technical Note 95-135.

4. J. Koster. "Measurement of Transverse Spin Asymmeteries in Polaized Proton-Proton Collisions and the Realization of New Electromagnetic Calorimeters for Forward Physics" 2010. http://www.phenix.bnl.gov/phenix/WWW/talk/archive/theses/2010/Koster_John-koster_john.pdf

5. http://pdg.lbl.gov/2011/AtomicNuclearProperites/

TSW for PHENIX Muon Piston Calorimeter (MPC) APD and Prototype MPC Extension (MPC-EX) Tests

SIGNATURES:

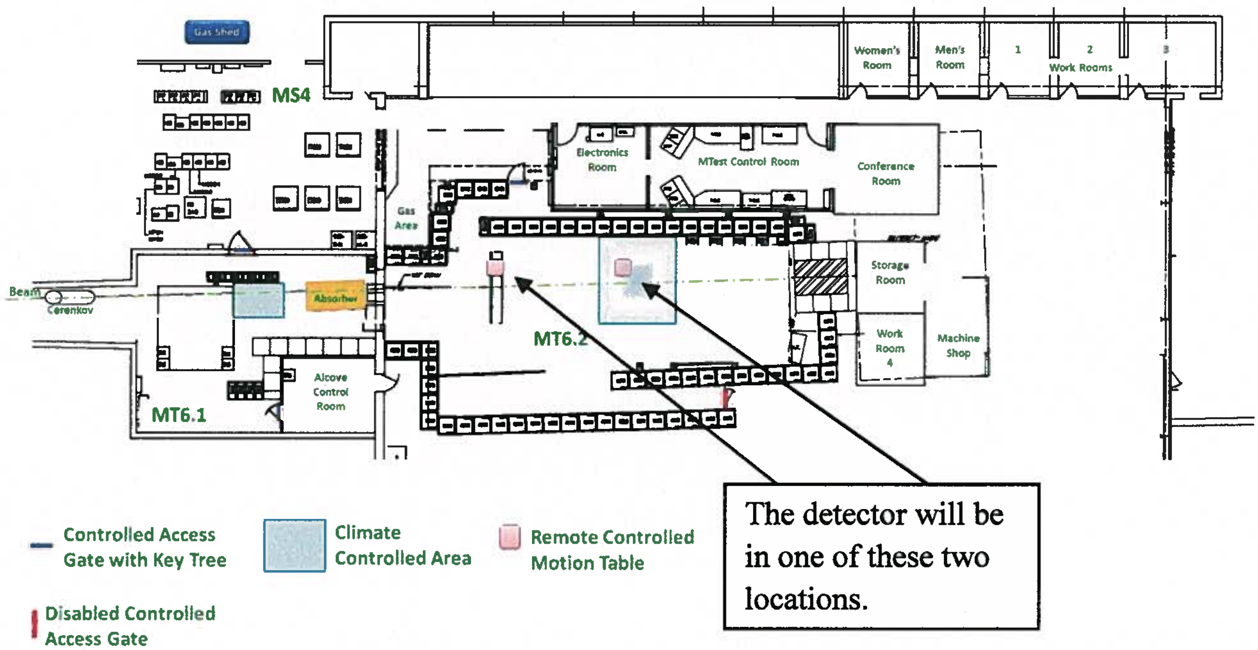
Sarah Campbell, Experiment Spokesperson 7/12/2013

Richard Seto, Experiment Spokesperson 7/15/2013

APPENDIX I: MT6 AREA LAYOUT

MT6.2B or 2C

MTEST AREAS



APPENDIX II: EQUIPMENT NEEDS

PROVIDED BY EXPERIMENTERS:

The wrapped crystal array, light tight box, MPC-EX prototype and respective readout electronics and additional data acquisition setup including computers will be brought by the MPC-EX group.

PREP EQUIPMENT POOL:

Quantity	Description
1	CAMAC Crate and power supply with CAMAC modules for readout
1	NIM Crate with cooling fans and NIM modules for beam trigger logic

PPD FTBF:

Quantity	Description
3	Multi-wire proportional chamber
2	Trigger scintillation paddles
1	Cherenkov counter
	Cables as needed

Appendix III: - Hazard Identification Checklist

Flammable Gases or Liquids		Other Gas Emissions		Hazardous Chemicals		Other Hazardous /Toxic Materials
Type:		Type:			Cyanide plating materials	List hazardous/toxic materials planned for use in a beam line or an experimental enclosure:
Flow rate:		Flow rate:			Hydrofluoric Acid	
Capacity:		Capacity:			Methane	
Radioactive Sources		**Target Materials**			photographic developers	
	Permanent Installation		Beryllium (Be)		PolyChlorinatedBiphenyls	
	Temporary Use		Lithium (Li)		Scintillation Oil	
Type:			Mercury (Hg)		TEA	
Strength:			Lead (Pb)		TMAE	
Lasers		X	Tungsten (W)		Other: Activated Water?	
	Permanent installation		Uranium (U)			
	Temporary installation	X	Other: PbWO4 crystal	**Nuclear Materials**		
	Calibration	**Electrical Equipment**		Name:		
	Alignment		Cryo/Electrical devices	Weight:		
Type:			Capacitor Banks	**Mechanical Structures**		
Wattage:			High Voltage (50V)		Lifting Devices	
MFR Class:			Exposed Equipment over 50 V		Motion Controllers	
			Non-commercial/Non-PREP		Scaffolding/ Elevated Platforms	
			Modified Commercial/PREP		Other:	
Vacuum Vessels		**Pressure Vessels**		**Cryogenics**		
Inside Diameter:		Inside Diameter:			Beam line magnets	
Operating Pressure:		Operating Pressure:			Analysis magnets	
Window Material:		Window Material:			Target	
Window Thickness:		Window Thickness:			Bubble chamber	

OTHER GAS EMISSION

Greenhouse Gasses (Need to be tracked and reported to DOE)

- ❑ Carbon Dioxide, including CO_2 mixes such as Ar/CO_2
- ❑ Methane
- ❑ Nitrous Oxide
- ❑ Sulfur Hexafluoride
- ❑ Hydro fluorocarbons
- ❑ Per fluorocarbons
- ❑ Nitrogen Trifluoride

NUCLEAR MATERIALS

REPORTABLE ELEMENTS AND ISOTOPES / WEIGHT UNITS / ROUNDING

Name of Material	MT Code	Reporting Weight Unit Report to Nearest Whole Unit	Element Weight	Isotope Weight	Isotope Weight %
Depleted Uranium	10	Whole Kg	Total U	U-235	U-235
Enriched Uranium	20	Whole Gm	Total U	U-235	U-235
Plutonium-242[1]	40	Whole Gm	Total Pu	Pu-242	Pu-242
Americium-241[2]	44	Whole Gm	Total Am	Am-241	–
Americium-243[2]	45	Whole Gm	Total Am	Am-243	–
Curium	46	Whole Gm	Total Cm	Cm-246	–
Californium	48	Whole Microgram	–	Cf-252	–
Plutonium	50	Whole Gm	Total Pu	Pu-239+Pu-241	Pu-240
Enriched Lithium	60	Whole Kg	Total Li	Li-6	Li-6
Uranium-233	70	Whole Gm	Total U	U-233	U-232 (ppm)
Normal Uranium	81	Whole Kg	Total U	–	–
Neptunium-237	82	Whole Gm	Total Np	–	–
Plutonium-238[3]	83	Gm to tenth	Total Pu	Pu-238	Pu-238
Deuterium[4]	86	Kg to tenth	D_2O	D_2	
Tritium[5]	87	Gm to hundredth	Total H-3	–	–
Thorium	88	Whole Kg	Total Th	–	–
Uranium in Cascades[6]	89	Whole Gm	Total U	U-235	U-235

[1] Report as Pu-242 if the contained Pu-242 is 20 percent or greater of total plutonium by weight; otherwise, report as Pu 239-241.

[2] Americium and Neptunium-237 contained in plutonium as part of the natural in-growth process are not required to be accounted for or reported until separated from the plutonium.

[3] Report as Pu-238 if the contained Pu-238 is 10 percent or greater of total plutonium by weight; otherwise, report as plutonium Pu 239-241.

[4] For deuterium in the form of heavy water, both the element and isotope weight fields should be used; otherwise, report isotope weight only.

[5] Tritium contained in water (H2O or D2O) used as a moderator in a nuclear reactor is not an accountable material.

[6] Uranium in cascades is treated as enriched uranium and should be reported as material type 89.

The following people have read this TSW:

Michael Lindgren, Particle Physics Division, Fermilab — 7 / 2 / 2013

Roger Dixon, Accelerator Division, Fermilab — 7 / 2 / 2013

Robert Roser, Scientific Computing Division, Fermilab — 7 / 2 / 2013

Martha Michels, ESH&Q Section, Fermilab — 7 / 2 / 2013

Greg Bock, Associate Director for Research, Fermilab — 7 / 3 /2013

Stuart Henderson, Associate Director for Accelerators, Fermilab — 7 / 1 /2013